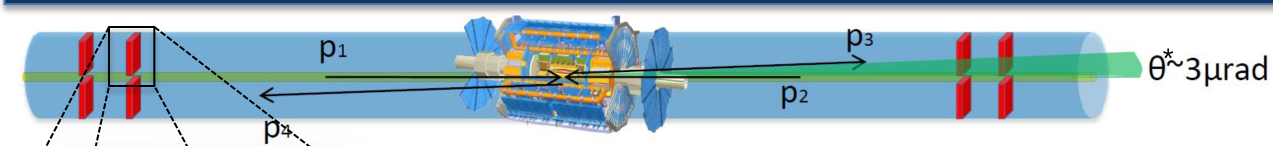
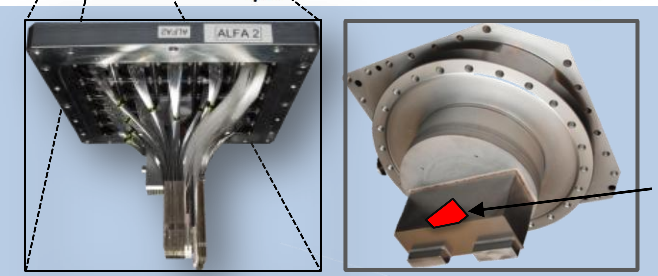
LHCC Poster Session - CERN, 21 March 2012

2011 ATLAS Detector Performance - ID and Forward detectors

This poster describes the performance of 2 parts of ATLAS:
- The Inner Detector which consists of 3 subdetectors: the Pixel detector, the SemiConductor Tracker (or SCT) and the Transition Radiation Tracker (or TRT). Here, we report on Pixel detector and SCT performance over 2011.
- ALFA detector which will determine the absolute luminosity of the CERN LHC at the ATLAS Interaction Point (IP), and the total proton-proton cross section, by tracking elastically scattered protons at very small angles in the limit of the Coulomb Nuclear interference region.

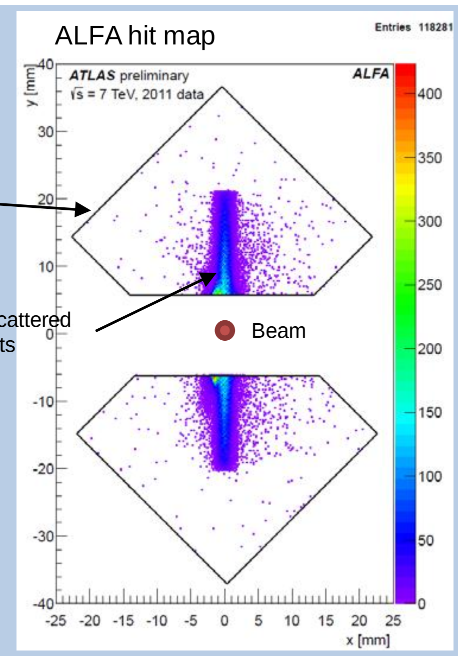
ALFA (Absolute Luminosity For ATLAS)





Side view of the scintillating fiber detector

The roman pot



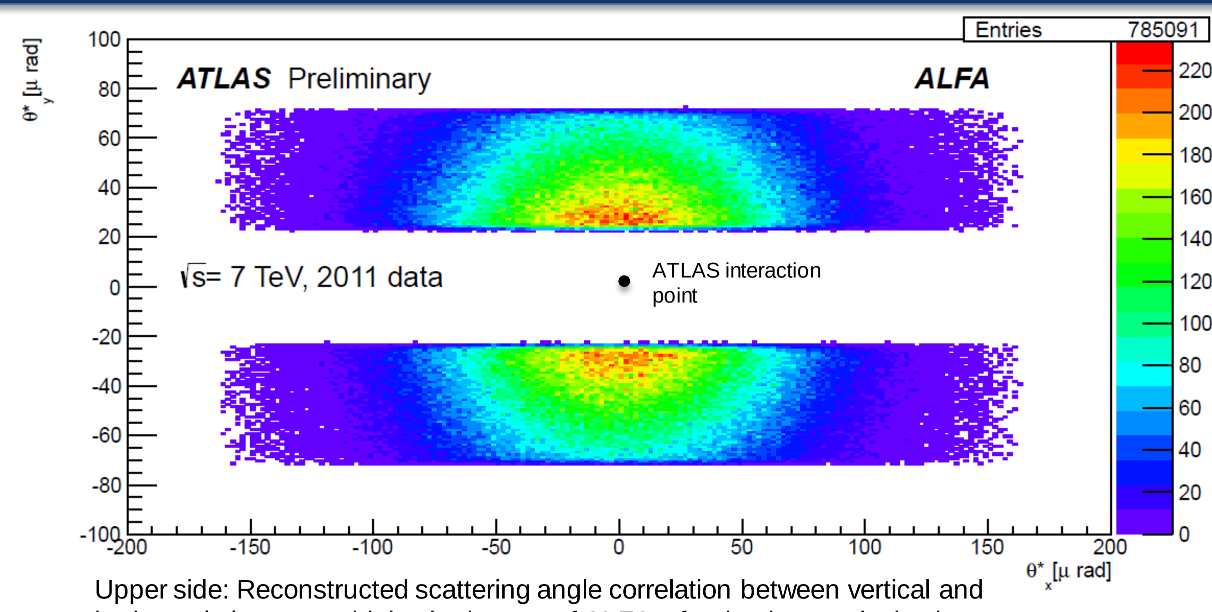
Detector:

ALFA tracker system is based on scintillating fibers and located in Roman Pots a few mm apart the LHC beam axis. 8 detectors are located at 240 m from the ATLAS Interaction Point (IP) to track scattered protons with a 30 μm position resolution.

Measurement principle:

Impact position on the fiber detector and optic parameters allow the reconstruction of the scattered angle at the IP ($\theta^*_{x,y}$), which will be needed to calculate the momentum transfer spectrum (*t-spectrum*), using the fact that at small θ^*, t can be written as: $t = (p_1 - p_3)^2 \approx -(p\theta^*)^2$

Background subtraction, acceptance and efficiency corrections will be applied on the *t-spectrum.*



Upper side: Reconstructed scattering angle correlation between vertical and horizontal planes combining both arms of ALFA, after background rejection cuts.

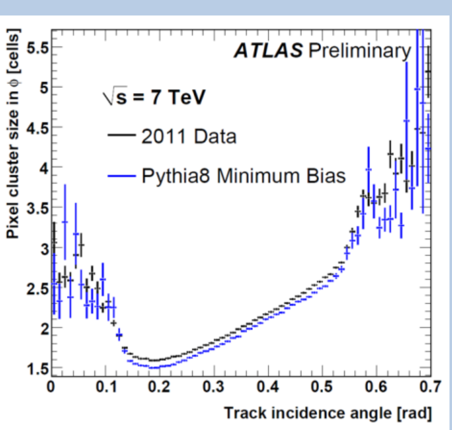
The number of elastic scattering events N_{el} is linked to the total cross section σ_{tot} through the optical theorem.
The challenge is to reach the Coulomb Nuclear interference region ($t<10^{-3}$ GeV^2), which will allow the absolute measurement of the luminosity and σ_{tot} .

In the beginning of 2011, 4 Roman Pot stations were installed in the LHC tunnel. Subsequently the commissioning of all readout components, the trigger system and the integration in the ATLAS data acquisition was performed. A first data taking at β^*=90 m was successfully done and the physics analysis is going on.

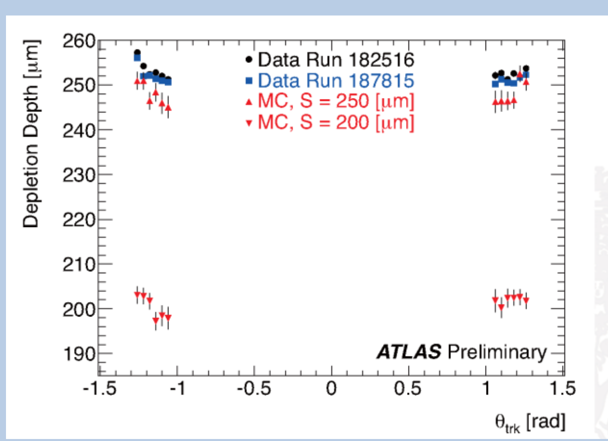
Pixel Detector (Pixel)

Pixel Cluster and Depletion Depth

Pixel cluster width is a function of the track incident angle, which can be used to extract the depleted depths of pixel sensors.



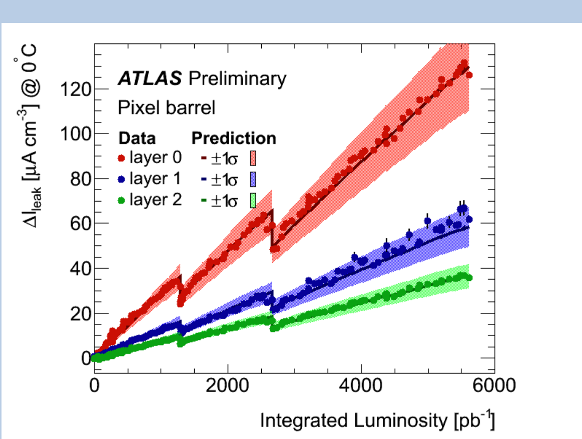
2011 data in cluster size vs incident angle has been good reproduced by MC simulation.



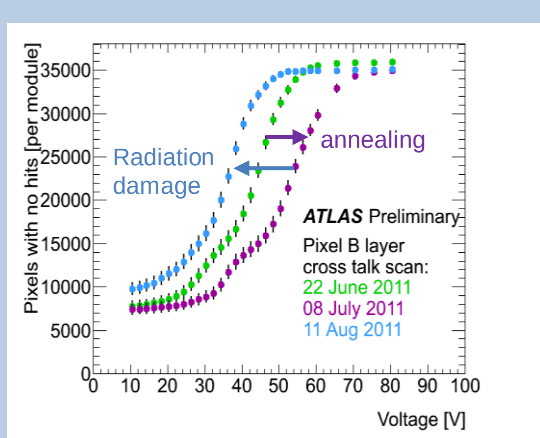
The detector ran fully depleted in 2011. The measured depletion depth is in agreement with the active sensor thickness of 250 μm.

Radiation Damage

The pixel detector is the ATLAS closest subsystem to the LHC beam, which will receive the largest irradiation doses in ATLAS (expect $10^{15} n_{eq} cm^{-2}$/50Mrad during the whole operation).



Leakage current follows integrated luminosity and steps consistent with annealing during detector warm-up periods. Very good agreement with “Dortmund” model (data scaled up: Layer 0 +15%, Layer 1 and 2 +30%.)

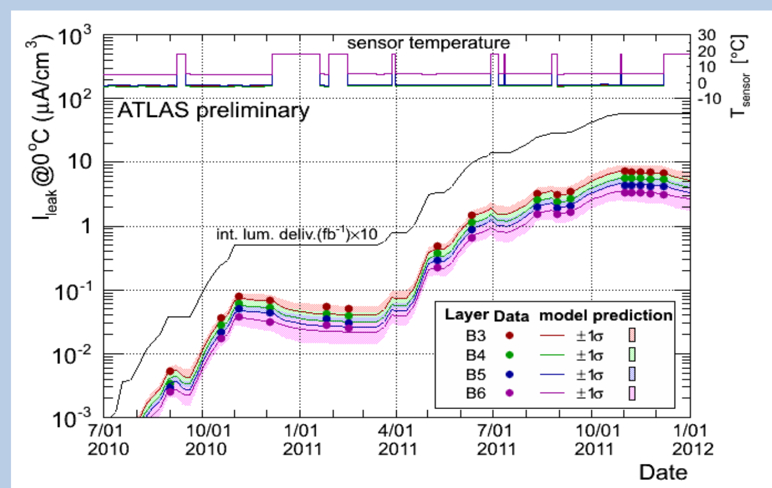


Before type inversion, the depletion voltage scan results show the reduction of cross-talk while increasing the high voltage. Annealing effects induced an increase of the depletion voltage.

SemiConductor Tracker (SCT)

Leakage Current

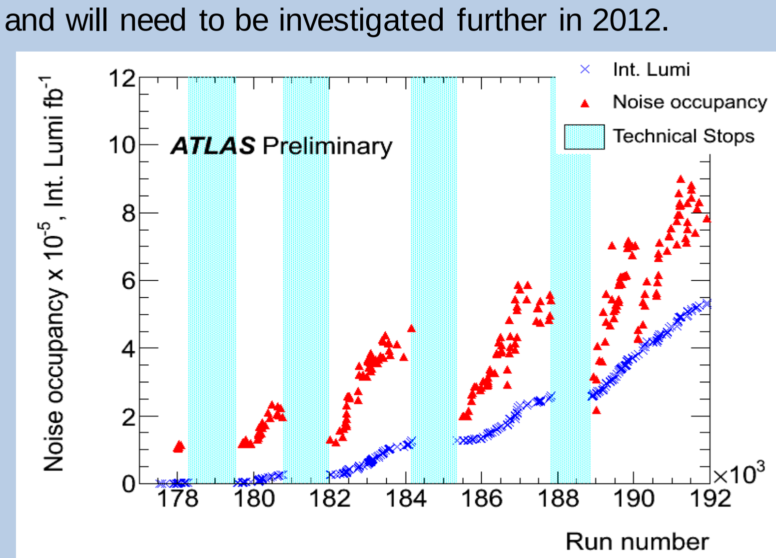
A major challenge the SCT must face is that of irradiation. Leakage current is an important measure of radiation damage. For the barrel of the SCT, the Hamburg-Dortmund model predicts to within 1 sigma the leakage current measured over the course of 2011. This excellent agreement gives confidence the SCT is performing as expected.



Noise Occupancy

The SCT noise occupancy is calculated by a new method using the ratio of the number of times a module has been hit on one side to the number of times it wasn't hit. If we call this ratio R and the number of strips in a module Ns, then the noise occupancy is described by the following equation: $NO = \frac{1}{Ns} \frac{R}{2+R}$

The mean noise occupancy has increased over 2011 and appears to rise with integrated luminosity, yet also has some unexpected sharp decreases- often after technical stops. This feature is yet to be understood but is thought to be related to the SCT calibration and will need to be investigated further in 2012.



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ATLAS EXPERIMENT